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WITNESS my hand this
Tenth day of March 2005

LEANNE MYNOTT
MANAGER EXAMINATION SUPPORT
AND SALES

P009
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Patents Act 1990

PROVISIONAL SPECIFICATION

Invention Title: **SELF-ALIGNING COUPLING APPARATUS**

The invention is described in the following statement:

SELF-ALIGNING COUPLING APPARATUS

FIELD OF INVENTION

The present invention relates generally to coupling apparatus, and in particular to a self-aligning coupling device for use, for example, in a clamping assembly of the type used to hold together flat articles, such as bench tops.

BACKGROUND OF INVENTION

It is known to use adjustable clamp assemblies, for example, to couple two objects together through a clamping action. Figure 1 illustrates an example in which two elongate objects A and B are to be clamped together end to end.

A known approach for clamping such objects together end to end involves creating cut-out portions in the objects, and using clamps to pull the cut-out portions together. An example of a suitable known cut-out arrangement is shown in Figure 2.

In Figure 2, the cut-out arrangement includes cut-away portions A", B" made in objects A and B respectively, so that known clamp mechanism 200 can be inserted into the combined cut-away portion A", B".

The known clamp mechanism 200 includes a first clamp member 202 that abuts an inner surface 203 of cut-away portion B", and a second clamp member 204 that abuts a corresponding inner surface of cut-away portion A". The clamp members 202, 204 are connected by a shaft 206 that passes through respective holes (not shown) in the clamping members 202, 204. The shaft 206 is free to rotate within the holes in the clamping members 202, 204, and is provided with a head portion 208 at one end that abuts an outer surface of the second clamping member 204.

The end of the shaft 206 opposed to the head 208 is provided with a screw thread 210, with which a nut 212 is threadably engaged. The nut 212 abuts an outer surface of the first clamping member 202. Accordingly, by tightening the nut 212, the two clamping members 204, 202 are drawn together, thus drawing the cut-away portions A", B" together in order to clamp together the objects A, B.

The problem remains, however, that it is difficult in many circumstances to manipulate the known clamp 200 in cut-away portions such as the ones designated as A", B" in Figure 2. In order to tighten the nut 212, it is necessary to use a spanner or other form of lever arm, which requires the spanner or lever

arm to be swept through an arc. Thus, when the clamp 200 resides in the cut-away portion A", B" it may be difficult to sweep the spanner or lever arm through the arc, because the walls and surface of the objects A, B tend to obstruct the sweep of the arc. At best, it is necessary to manipulate the spanner in very small increments, because the walls of the cut-away portion, B" limit the sweep of the arc.

Exacerbating the difficulty is the fact that, in use, this form of clamping is often employed on the under surfaces of benches or tables, where the inaccessibility of the clamp within a confined area may be a problem.

Shown in Figure 3 is an alternative type of clamping assembly, as described in prior Australian provisional patent application no. 2004901112, which is incorporated herein in its entirety by reference. Similar clamping assemblies are also disclosed in PCT/AU03/01007, which is also incorporated herein in its entirety by reference. As illustrated in Figure 3, a clamp assembly includes an adjustable engagement assembly 302, which includes a gear assembly and housing, the housing also acting as a clamp member to bear against an inner surface of cut away portion A". The clamp assembly also includes a connection member 304, in the form of a threaded bolt. The connection member 304 engages with clamp member 306 installed within cut away portion B".

The clamp assembly shown in Figure 3 simplifies installation by enabling the clamp to be adjusted simply by applying torque using a screwdriver, electric drill with a screwdriver bit or other suitable implement inserted within recess 308 within the upper bevelled gear of the gear assembly in adjustable engagement assembly 302. Accordingly, it is not necessary to use a spanner or other lever arm to tighten the clamp, making it possible to install the clamp assembly more quickly and easily, especially in relatively inaccessible spaces.

However, with the assembly shown in Figure 3 it is still necessary to install the complete clamp assembly into the cutaway portions A" and B" of objects A, B by inserting it into the cutaway portions when assembling an article by clamping the objects together.

Accordingly, there is a need for an improved means of coupling two objects that mitigates at least some of the limitations of prior art clamping assemblies.

It is to be noted that any discussion of documents, devices, acts or knowledge in this specification is included to explain the context of the invention. It should not be taken as an admission that any of the material formed part of the prior art base or the common general knowledge in the relevant art on or before the priority date of the claims herein.

SUMMARY OF THE INVENTION

The present inventors have recognised that, in some circumstances, it may be desirable to preinstall a clamping assembly into object A at the time of manufacture, or shortly thereafter, and subsequently engage clamp member 306 within the cutaway portion B" of object B on site, when assembling a complete article from the objects. The objects may be for example, sections of a kitchen benchtop that are assembled to form a complete benchtop.

In this case, the inventors have recognised that it is particularly desirable that the clamp assembly be retracted entirely within cutaway portion A" until it is required to assemble the complete article by coupling object A to object B. Using the known clamp assembly shown in Figure 3, it is not possible to fully retract clamp member 306 into the cutaway channel in object A. Furthermore, it is still necessary to slot the extended connection member 304 and clamp member 306 into cutaway portion B". In order to do so, it is of course necessary that cutaway portion B" be open and readily accessible during construction. It is not possible using the assembly shown in Figure 3 to extend the clamp member 306 directly into the open end of cutaway portion B" formed in the end surface of object B at which the objects are to be clamped together. The clamp member 306 may be too large to fit within the channel of cutaway portion B" and in any case the clamping assembly provides no mechanism to ensure that once the clamp member 306 is in place within the desired region of cutaway B", it is then rotated into an appropriate orientation to bear against the inner surface of the cutaway portion B".

In particular, the present inventors have recognised that the clamping assembly shown in Figure 3 cannot be used reliably if cutaway portion B" is entirely enclosed within object B such that the only point of entry for the clamp member 306 and connection member 304 is via the opening in the end surface of object B that is to be clamped against object A.

Accordingly, the present invention provides a self aligning coupling device for installation in a channel having an open end and a pair of substantially parallel side walls, the device including:

an elongate connecting portion having a longitudinal axis;

a channel abutment portion; and

at least one laterally projecting lug,

arranged such that in use the coupling device may be installed in the channel with the channel abutment member located at least partially within the channel and the laterally projecting lug located outside the open end of the channel,

the channel abutment portion being formed such that when aligned in a first angular position within the channel it abuts the side walls of the channel to prevent rotation of the device in a first rotational direction about said longitudinal axis, while allowing rotation in a second, opposed, rotational direction, and

the lug being formed such that in said first angular position it extends beyond at least one of the side walls of the channel, whereby when the coupling device is retracted into the channel while simultaneously applying a torque to rotate the device in said first rotational direction towards said first angular position, the channel abutment portion will abut the side walls of the channel thereby aligning the lug to extend beyond at least one of the side walls of the channel to prevent the coupling device from being fully retracted into the channel.

Accordingly, once the coupling device has been inserted into a channel such that the projecting lug is outside the open end of the channel, the action of subsequently retracting the device while applying a torque causes it to self align such that the projecting lug is blocked from re-entering the channel due to its extension beyond the side wall of the channel. Therefore, when a coupling device in accordance with the invention is used as part of a clamp assembly to couple or clamp two objects together, it is not necessary to be able to access the open end of the channel, or to manually align the lug to ensure the correct engagement of the coupling device with a surface adjacent to the side walls of an open end of the channel in order to apply a clamping force thereto.

It is preferred that the coupling device includes two opposing laterally projecting lugs formed to extend beyond both side walls of the channel when the

coupling device is aligned in the channel in said first angular position. This arrangement provides improved support and stronger clamping force by enabling the coupling device to engage with adjacent surfaces on both sides of the open end of the channel.

In preferred embodiments, the lug or lugs are formed so that when they are aligned substantially parallel to the side walls of the channel they are able to fit therebetween such that the coupling device is freely slidable within the channel.

Accordingly, preferred embodiments of the device can be installed in the channel from an opening at a far end opposed to said open end by aligning the lugs in this manner and sliding the device through the channel. In this case, there is no need for access to the channel via an open face. The channel may therefore by wholly embedded within an object. Even where the channel has an accessible open face, it may in many cases be faster to install the coupling device by inserting it into the channel from the far end.

In particular, a clamping assembly including a coupling device in accordance with a preferred embodiment of the invention may be preinstalled in an object, such as a bench top, which may then be rapidly clamped to an adjacent bench top by operating an adjustable engagement assembly of the clamp to extend the coupling device into a channel formed in a cutaway portion in the second bench top.

It is further preferred that the channel abutment portion is formed such that when the lugs are aligned substantially parallel to the side walls of the channel, the channel abutment portion is aligned within the channel in a second angular position at which it abuts the side walls of the channel to prevent rotation of the device in said second rotational direction about said longitudinal axis, while allowing rotation in said first rotational direction.

In this preferred arrangement, the coupling device may be installed in the channel by extending it through the channel from the far end opposed to said open end, while simultaneously applying a torque to rotate the device in said second rotational direction. The stopping of the channel abutment portion at said second angular position ensures that the lugs remain aligned parallel to the side

walls of the channel, even if they have been extended to a location outside the open end of the channel.

In preferred embodiments, therefore, the coupling device of the present invention provides for particularly simple installation, by first extending the coupling device through the channel while applying a torque in said second rotational direction, until the lugs are wholly extended to a location outside the open end of the channel. Subsequently, the coupling device may be retracted while applying a torque in said first rotational direction causing the coupling device to rotate into said first angular position, whereby the lugs prevent the coupling device from being fully retracted into the channel, and may bear against a surface or surfaces adjacent to the open end of the channel in order to apply a clamping force.

The elongate connecting portion may include a cylindrical portion having a thread formed thereon for screw thread engagement with a cooperatively threaded adjustment member. The adjustment member may be a nut or similar internally threaded member through which the elongate connecting portion may pass.

However, the cooperatively threaded adjustment member is most preferably the threaded rotatable sleeve member of an adjustable engagement assembly such as are disclosed in international application no. PCT/AU03/01007 or Australian provisional patent application no. 2004901112.

According to such preferred arrangements, rotation of the threaded adjustment member results in translation of the coupling device along the channel, while, additionally, friction between the thread of the elongate connecting portion and the cooperative thread of the adjustment member, applies a torque to the coupling device. Accordingly, installation of the coupling device by simultaneous application of appropriate torque while first extending and then retracting the coupling device through the channel is simply carried out by operation of the adjustment member in the usual manner.

Part or all of the thread formed on the elongate connecting portion may be manufactured so as to be a snug fit with the adjustment member in order to increase the friction therebetween, and provide a suitable level of torque.

Alternatively, if required, a thin coating of a suitable material, such as a wax or lacquer, may be applied to the thread to increase friction and torque.

The thread formed on the elongate connecting portion may be a left hand thread, such that the first rotational direction is counterclockwise around the longitudinal axis as viewed from the end proximate the adjustment member. This arrangement is particularly preferred for use with the adjustable engagement assembly described in Australian provisional patent application no. 2004901112, so that the clamp assembly is tightened by clockwise rotation of the first bevel gear member of said engagement assembly.

Alternatively, the thread formed on the elongate connecting portion may be a right hand thread, in which case the first rotational direction will be clockwise.

In a particularly preferred embodiment, the coupling device includes two lugs integrally formed at an end thereof, to form a head portion having substantially rectangular cross section. The dimension of the rectangular cross section along a major axis thereof is preferably greater than the channel width such that when located outside the open end of the channel with said major axis perpendicular to the channel walls, corresponding to the first angular position, the lugs prevent the device from being fully retracted into the channel.

Further, it is preferred that a dimension of the rectangular section along a minor axis thereof is less then the channel width to enable the head portion to fit between the side walls when aligned with the minor axis perpendicular to the channel walls, corresponding to the second angular position of the device.

The substantially rectangular cross-section may include rounded portions at corners thereof to prevent corresponding edges of the head portion catching on a surface of an object in which the channel is formed, when rotating between the first and second angular positions.

Preferably, the first and second angular positions are arranged substantially at right angles to one another.

The edges and corners at the end of the head portion may be rounded or smoothed to ensure that there are no angular corners or edges that may catch on a surface of an object in which the channel is formed when the device slides within the channel.

The head portion preferably includes surfaces formed to bear against corresponding surfaces adjacent to the open end of the channel.

The channel abutment portion preferably includes two pairs of flat surfaces, each pair of surfaces meeting an edge therebetween, and the pairs being substantially opposed to each other relative to the longitudinal axis of the coupling device.

According to this preferred arrangement, in each of said first and second angular positions, one of each of said pairs of surfaces is located adjacent to a respective side wall of the channel.

It is particularly preferred that each of said pairs of surfaces meet at right angles, and are arranged such that in each of said first and second angular positions one of each of said pairs of surfaces bears against a respective side wall of the channel.

The pairs of surfaces are preferably opposed along an axis oriented at 45 degrees to the major and minor axes of the rectangular cross-section of the head of the coupling device. Accordingly, in preferred arrangements said first and second angular positions are substantially at right angles to each other such that in the first angular position the head portion is aligned with its major axis perpendicular to the channel walls, and the second angular position the head portion is aligned with its minor axis perpendicular to the channels walls.

In a particularly preferred embodiment, the channel abutment portion is formed integrally with the head portion, such that one of each of said pairs of surfaces is continuous with a corresponding surface of the head portion located on a side parallel to the major axis of the substantially rectangular cross-section. Accordingly, in the second angular position, the head portion and channel abutment portion fit within the channel with said continuous surfaces located adjacent to and parallel with respective parallel sides of the channel. This arrangement ensures that the head portion and channel abutment portion are smoothly and securely guided within the channel.

The coupling device may further include at least one nib that engages with a corresponding recess in an adjustable engagement assembly such as the assembly disclosed in Australian provisional patent application no. 2004901112, the nib and recess being arranged such that when engaged the coupling device is

retained in an angular position relative to the engagement assembly suitable to enable the complete clamping assembly formed thereby to be inserted into a corresponding cutaway in an object to be clamped, with the coupling device oriented in said second angular position within a channel of said cutaway. According to this arrangement, the complete assembly may easily be preinstalled in one object in an appropriate orientation to enable rapid connection to another object having a corresponding cutaway section, including a channel to receive the coupling device.

The coupling device may be formed as a single part, or alternatively may be assembled from multiple parts. In one preferred embodiment, the coupling device is formed from two parts, the first part including the head portion and channel abutment portion, and the second part including the elongate connecting portion.

BRIEF DESCRIPTION OF THE DRAWINGS

Further benefits and advantages of the coupling device of the present invention will become apparent in the following description of a preferred embodiments of the invention, which should not, however, be considered to limit the scope of the invention or any of the preceding statements. In order that the invention might be more fully understood, an embodiment of the invention will be described with reference to the accompanying drawings, in which:

Figure 1 is a side view of two flat objects which are to be clamped together end to end;

Figure 2 is a plan view of a prior art clamp positioned in a cut-away portion;

Figure 3 shows an alternative clamp assembly fully assembled and located within suitable cut-away portions;

Figure 4 shows a coupling device in accordance with a preferred embodiment of the invention;

Figure 5 shows cross-sectional views of a head portion and channel abutment portion of the coupling device of Figure 4;

Figures 6A and 6B are cross-sectional views illustrating the coupling device of Figure 4 engaged in a channel in first and second angular positions;

Figure 7 illustrates the coupling device of Figure 4 engaged with an adjustable engagement assembly; and

Figure 8 illustrates a complete clamp assembly including the coupling device of Figure 4 and adjustable engagement assembly installed within two objects to be clamped together.

Figure 9 illustrates an alternative embodiment of the invention, in which the coupling device is formed in two parts.

DESCRIPTION OF PREFERRED EMBODIMENTS

Figure 4 illustrates a preferred embodiment of a coupling device 400 in accordance with the present invention, while Figure 5 shows a side view of the same coupling device, along with cross-sections taken at various distances along the device. Like reference numerals in each of the drawings indicates like components.

The coupling device 400 includes an elongate connecting portion 402, which in preferred embodiments is a cylindrical portion having a screw thread 406 formed thereon for screw thread engagement with a cooperatively threaded adjustment member. The elongate connecting portion 402 has a longitudinal axis 404.

The coupling device 400 also includes channel abutment portion 408 and head portion 410.

The head portion 410 includes two laterally projecting lugs 412, 414. The lugs are arranged such that when the coupling device 400 is installed in a channel, as will be described subsequently with reference to Figure 8, they may be located outside an open end of the channel, and extend beyond the walls of the channel. When installed in this manner, surfaces 418, 416 may bear against corresponding surfaces adjacent to the end of the channel to prevent retraction of the coupling device 400 into the channel.

As shown in cross-section 5A of Figure 5, head portion 410 has a substantially rectangular cross-section 502. The substantially rectangular cross-section 502 has a long dimension along major axis 504, and a short dimension along minor axis 506. The dimensions are chosen such that the head portion 410 is able to fit within a channel having substantially parallel side walls when oriented such that minor axis 506 is arranged perpendicular to the side walls of the channel. However, the width of the channel may be such that when head portion

410 is oriented with minor axis 506 parallel to the side walls, it is unable to fit within the channel.

In order to align head portion 410 in the desired manner during installation and operation of the coupling device, channel abutment portion 408 is provided, having the features shown in cross-section 5B of Figure 5. As shown, in preferred embodiments the channel abutment portion includes a first pair of flat surfaces 508a, 508b substantially opposed to a second pair of flat surfaces 510a, 510b along an axis 512 that is oriented at 45 degrees to the major and minor axes 504 and 506 respectively of rectangular cross-section 502 of head portion 410. Each of said pairs of flat surfaces meet at right angles, such that surfaces 508a and 510a are oriented parallel to major axis 504, and surfaces 508b and 510b are oriented parallel to minor axis 506.

Figures 6A and 6B illustrate in cross-section the coupling device 400 located within a cutaway channel 600 in a first angular position and second angular position respectively around longitudinal axis 404. It should be noted that Figures 6A and 6B are not drawn to scale.

Figure 6A shows coupling device 400 in a first angular position within channel 600. Oriented in this manner, surfaces 508b and 510b of channel abutment portion 408 bear against parallel side walls 602, 604 of channel 600. Accordingly, as shown in Figure 6A the coupling device is unable to rotate within the channel in a first rotational direction, being a counterclockwise direction, however it is able to rotate within the channel 600 in a second rotational direction, being a clockwise direction. As indicated by the broken lines in Figure 6A, in the first angular position the head portion 410 is located beyond an open end of the channel 600, and is oriented such that it is not possible to retract the coupling device through the channel 600, due to the engagement of surfaces 418, 416 with respective corresponding surfaces adjacent to walls 602, 604 of the open end of channel 600.

Accordingly, if a counterclockwise torque is applied to the coupling device while simultaneously attempting to retract the device through channel 600, the device will rotate into the first angular position shown in Figure 6A and then be prevented from further rotation by engagement of surfaces 508b, 510b of channel abutment portion 408 with side walls 602, 604. Accordingly, such a process of

simultaneous retraction and application of counter clockwise torque results in the coupling device self aligning within the channel 600 so as to prevent retraction of the device and causing surfaces 418 and 416 to bear against corresponding surfaces adjacent to the open end of channel 600 in order to provide a clamping force along the longitudinal axis of the device.

Figure 6B illustrates the coupling device in a second angular position within channel 600, whereby surfaces 508a and 510a engage with channel walls 602 and 604 respectively, preventing clockwise rotation of the coupling device, while allowing it to rotate in a counter clockwise direction about longitudinal axis 404.

In the second angular position shown in Figure 6B, head portion 410 is oriented with major axis 504 aligned parallel to side walls 602, 604 such that the head portion 410 is able to slide freely within the channel 600.

Accordingly, by applying a clockwise torque to the coupling device 400 while simultaneously extending or retracting the device within channel 600, the coupling device will be held in the orientation shown in Figure 6B by the engagement between surfaces 508a and 510a with parallel side walls 602 and 604 so as to maintain the alignment of major axis 504 with the side walls, and ensure that the coupling device remains freely slidable within channel 600.

The substantially rectangular cross-section 502 of head portion 410 includes rounded or smoothed portions 518, 520 adjacent to the diagonally opposed corners corresponding to the positions of the flat surfaces 508a, 508b, 510a, 510b of the channel abutment portion 408, to prevent the head portion catching on a surface of the object in which the channel is formed during rotation between the first and second angular positions. Additionally, the remaining pair of diagonally opposed corners 522, 524, as well as end portions 526, 528 of head portion 510 are rounded and/or smoothed to ensure that there are no angular corners or edges that may catch on a surface of an object during sliding and/or rotation of the coupling device within channel 600.

Installation of the coupling device may thus be carried out as follows. The device is first oriented in the second angular position as shown in Figure 6B. In this orientation, the coupling device may be extended through the channel 600 while simultaneously applying a clockwise torque to ensure that the device

remains aligned in the channel in the second angular position. In the preferred embodiment of the coupling device 400 the flat surfaces 508a, 510a adjacent to side walls 602, 604 are continuous with corresponding side surfaces, eg 420, of head portion 410, as indicated in Figure 4. Accordingly, during extension of the coupling device through channel 600, the device is guided smoothly and securely within the channel.

Once the head portion 410 has been extended outside an open end of the channel, surfaces 508a, 510a of the channel abutment portion 408 remain in contact with side walls 602, 604 under the influence of the clockwise torque to ensure that the head portion 410 of the coupling device remains aligned with the channel 600 in the second angular position during further extension of the device.

Following extension of the head portion 410 for a sufficient distance outside the open end of channel 600, the coupling device 400 is retracted back into the channel 600 while simultaneously applying a counterclockwise torque. The applied torque will cause the coupling device to rotate into the first angular position shown in Figure 6A during retraction, until flat surfaces 508b, 510b make contact with side walls 602, 604 of channel 600 preventing further rotation. In this orientation, head portion 410 is aligned across the channel, such that surfaces 416, 418 of head portion 410 will make contact with corresponding surfaces adjacent to the open end of the channel 600, preventing the coupling device from being fully retracted back into channel 600.

For optimum installation of coupling device 400, the head portion should be allowed to extend outside the open end of channel 600 during extension of the device by a sufficient distance to allow full rotation of the device from the second angular position to the first angular position under the torque applied during subsequent retraction.

The extension or retraction of the coupling device while simultaneously applying the required torque may be simply achieved through the operation of a threaded adjustment member engaged with screw thread 406 formed on cylindrical connecting portion 402 of the coupling device 400. The threaded adjustment member may be a nut or the like, however it is preferably a threaded rotatable sleeve member of an adjustable engagement assembly, such as the assembly disclosed in Australian provisional patent application no. 2004901112.

Such an adjustable engagement assembly 704 is shown engaged with the thread of the cylindrical portion of coupling device 400 in Figure 7. Operation of the engagement assembly 704 by rotation of gear member 710 results in corresponding rotation of the threaded rotatable sleeve member (not visible in Figure 7) that is engaged by screw thread engagement with the coupling device 400.

Rotation of the threaded sleeve member will result in translation of the coupling device 400 along its longitudinal axis relative to the engagement assembly 704. However, friction between the thread of the threaded rotatable sleeve member and the thread formed on the cylindrical portion of the coupling device will simultaneously apply a corresponding torque to the coupling device about its longitudinal axis. Part or all of the thread 406 may be formed so as to be a snug fit in the threaded rotatable sleeve member of the adjustable engagement assembly, to increase the friction between the cooperative thread and therefore increase the applied torque. Alternatively, a thin coating of a substance such as wax or a lacquer may be applied to all or part of the thread 406 to provide additional friction, and enhance torque.

As shown in the drawings, in the preferred embodiment 400 the thread 406 of the coupling device is a left hand thread. Accordingly, operation of the adjustable engagement assembly 704 to retract the head portion of coupling device 400 towards the engagement assembly 704 results in the simultaneous application of a counterclockwise torque. Accordingly, retraction of the coupling device 400 is accompanied by a simultaneous rotation in a counterclockwise direction, which in use as previously described will result in rotation from the second angular position to the first angular position as shown in Figures 6B and 6A. The use of a left hand thread 406 is particularly preferred when the coupling device is used in a clamping assembly with the adjustable engagement assembly disclosed in Australian provisional patent application no. 20049101112, so that the clamp assembly is tightened by a clockwise rotation of the gear member 710 of the engagement assembly 704. However, it will be appreciated that the coupling device could also be provided with a standard right hand thread, with corresponding modifications also made to channel abutment portion 408 and head portion 410 such that the first angular position is achieved by a clockwise

rotation, rather than a counterclockwise rotation, from the second angular position.

Figures 4 and 7 also show nib 706 formed on the coupling device 400, that is able to engage with corresponding recess 708 of the adjustable engagement assembly 704. As can be seen, when the head portion of the coupling device is fully retracted towards the engagement assembly, the nib 706 will engage within recess 708 to maintain a fixed orientation of the coupling device relative to the engagement assembly. This orientation is suitable to insert the complete clamping assembly into a corresponding cutaway portion of an object to be clamped such that the coupling device is correctly oriented in the second angular position shown in Figure 6B, ready for extension through a channel in the cutaway region of the object.

Figure 8 shows the clamping assembly of Figure 7 installed in cutaway portions formed in objects 802 and 804. Prior to clamping of the objects, the clamping assembly may be preinstalled within the cutaway portion of object 802, with the coupling device 400 fully retracted into cutaway channel 806. Rear channel section 818 is provided to accommodate the threaded connecting portion of the coupling device when fully retracted in this way.

The preinstalled clamping assembly may be operated to clamp objects 802, 804 together by first abutting the surfaces to be clamped such that channels 806, 808 in corresponding cutaway portions are aligned. The clamping assembly is then operated in the manner previously described to extend the coupling device through channels 806, 808 until the head portion of coupling device 400 extends outside the open end of channel 808 into the circular cutaway region 812. Once the head portion of coupling device 400 is fully extended into cutaway region 812, the engagement assembly 816 is then operated so as to retract the coupling device 400, while simultaneously rotating it into the first angular position as shown in Figure 8, whereby the surfaces 416, 418 of the head portion of the coupling device 400 bear against the inner surfaces of cutaway region 812 adjacent to the open end of channel 808. The outer surface of the housing of the engagement assembly 816 bears against corresponding inner surfaces of circular cutaway region 810. Accordingly, in the arrangement shown in Figure 8 further

tightening of the clamping assembly will result in the clamping together of objects 802, 804.

It will be appreciated that since the coupling device 400 is self aligning into the position shown in Figure 8 upon retraction and tightening of the clamping assembly, it is not necessary to access the cutaway portion 812 in object 804 in order to correctly align the head portion of coupling device 400. Accordingly, the channel 808 and circular cut away portion 812 may be inaccessible, or even fully enclosed within object 804. Furthermore, operation of the clamping assembly to clamp together objects 802, 804 may be completed very rapidly through the use of a mechanised tool such an electric screw driver or electric drill having a screwdriver bit. The tool is applied to adjustable engagement assembly 816 first on a setting normally used to loosen a screw, applying a counter clockwise rotation to the rotatable gear 820 to extend the coupling device, and then switched to the opposite setting to retract and align the coupling device, and clamp the two objects together.

Figure 9 illustrates an alternative embodiment of a coupling device 900 which is formed from two separate parts 902, 904. First part 902 includes a cylindrical connection portion having a screw thread 903 formed thereon, in like manner to screw thread 406 formed on the connecting portion 402 of the first embodiment 400. Second part 904 includes integrally formed channel abutment and head portions 905, 907 similar to corresponding portions 408, 410 of the first embodiment 400.

A substantially cylindrical channel 908 is formed through second part 904, having an opening 906 through which first part 902 may be passed. The cylindrical channel 908 is slightly tapered between opening 906, and the opening 909 at the opposing end of the channel 908 (blocked by first part 902 in Figure 9). First part 902 includes a corresponding wedge-shaped portion 910 formed at an end thereof, such that when the first part 902 is pushed through channel 908, the outer surface of wedge-shaped portion 910 bears against the inner surface of tapered channel 908 to prevent the first part 902 from passing completely through the second part 904. Accordingly, the two parts 902, 904 become wedged together to form the coupling device 900. By including small serrations, e.g. 912,

of the outer surface of wedge-shaped portion 910 and/or the inner surface of tapered channel 908, the part 902, 904 may be more securely lodged together.

Furthermore, when the two-part coupling device 900 is used in a clamping assembly, the wedge-shaped portion 910 of first part 902 will be more tightly drawn into the tapered channel 908 by the clamping action, such that the assembly is secure in use, and the two parts 902, 904 cannot come apart as the clamp is tightened.

One potential advantage of the alternative embodiment of the coupling device 900 is that it may be possible to reduce the cost of manufacture, since the two parts 902, 904 may be manufactured separately, and of different materials. For example, first part 902 may be formed by rolling a thread onto a rod made from a suitable metal. Second part 904 may be separately formed, e.g. from aluminium, by a die casting process.

It will be appreciated that the foregoing preferred embodiments have been advanced by way of example only, and modifications that would be apparent to those of skill in the art are possible within the scope of the invention. For example the connecting portion may be other than a cylindrical threaded portion, and may be formed in other shapes able to be held and operated to apply the required torque and translation of the coupling device. Also, in alternative arrangements, the channel abutment portion need not be formed integrally with a head portion, and may be located along the coupling device at another position in which it will remain within the channel while the head portion, or other arrangement of one or more laterally projecting lugs, extend beyond an open end of the channel.

Furthermore, the laterally projecting lugs need not be located at an end of the coupling device, and may extend laterally from an alternative location along the device. In the preferred embodiments the coupling device is formed from a single part, or from two parts, however it will be appreciated that a coupling device according to the invention could be formed using a greater number of parts. For example, the connecting portion, channel abutment portion, and laterally projecting lug or lugs may be formed as separate parts.

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RAPIDJOINT PTY LTD

WATERMARK PATENT & TRADE MARK ATTORNEYS
290 BURWOOD ROAD
HAWTHORN VICTORIA 3122
AUSTRALIA

P24301AUP1: RLT/MAS/AXO

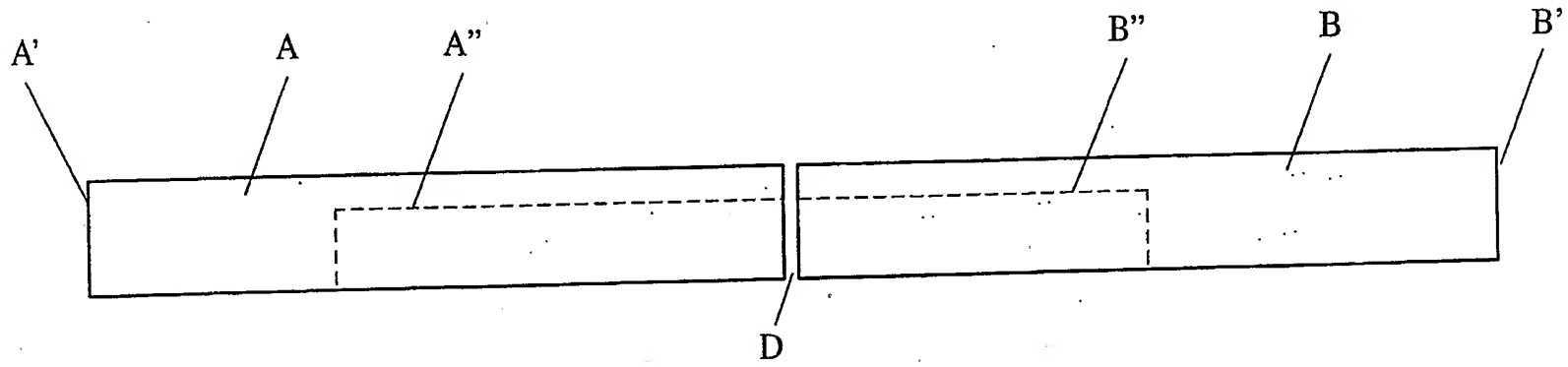


FIGURE 1

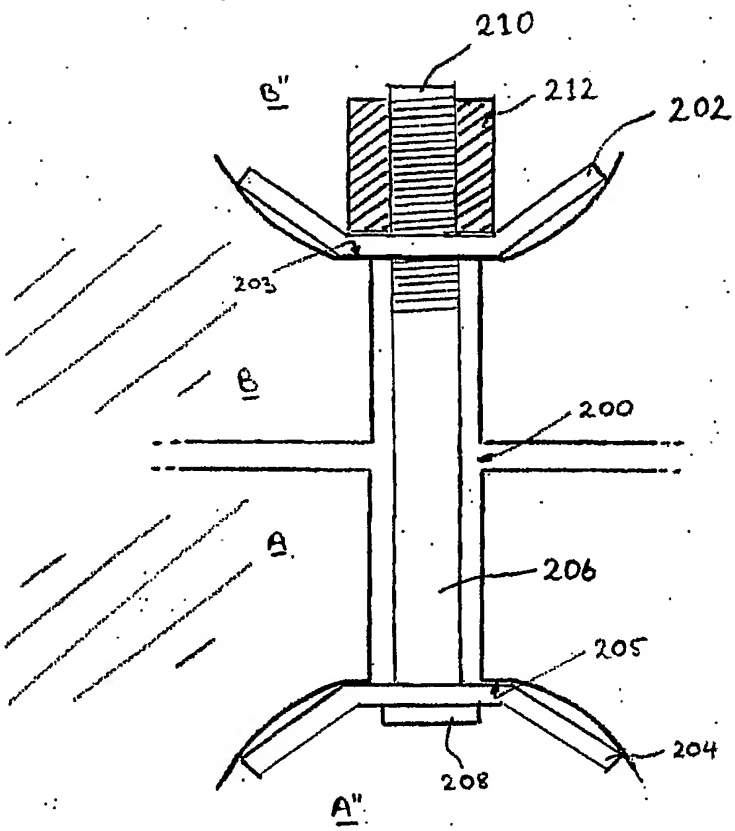


FIGURE 2

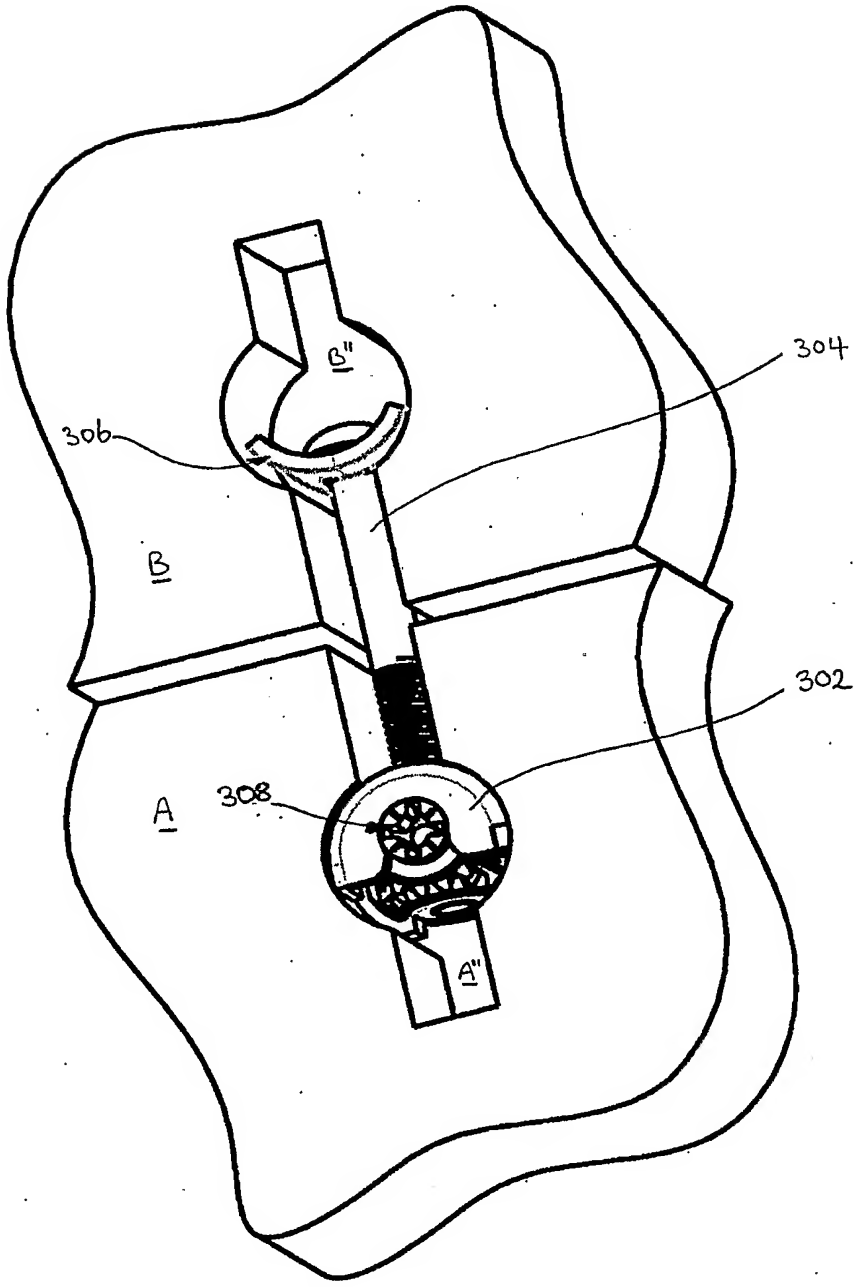


FIGURE 3

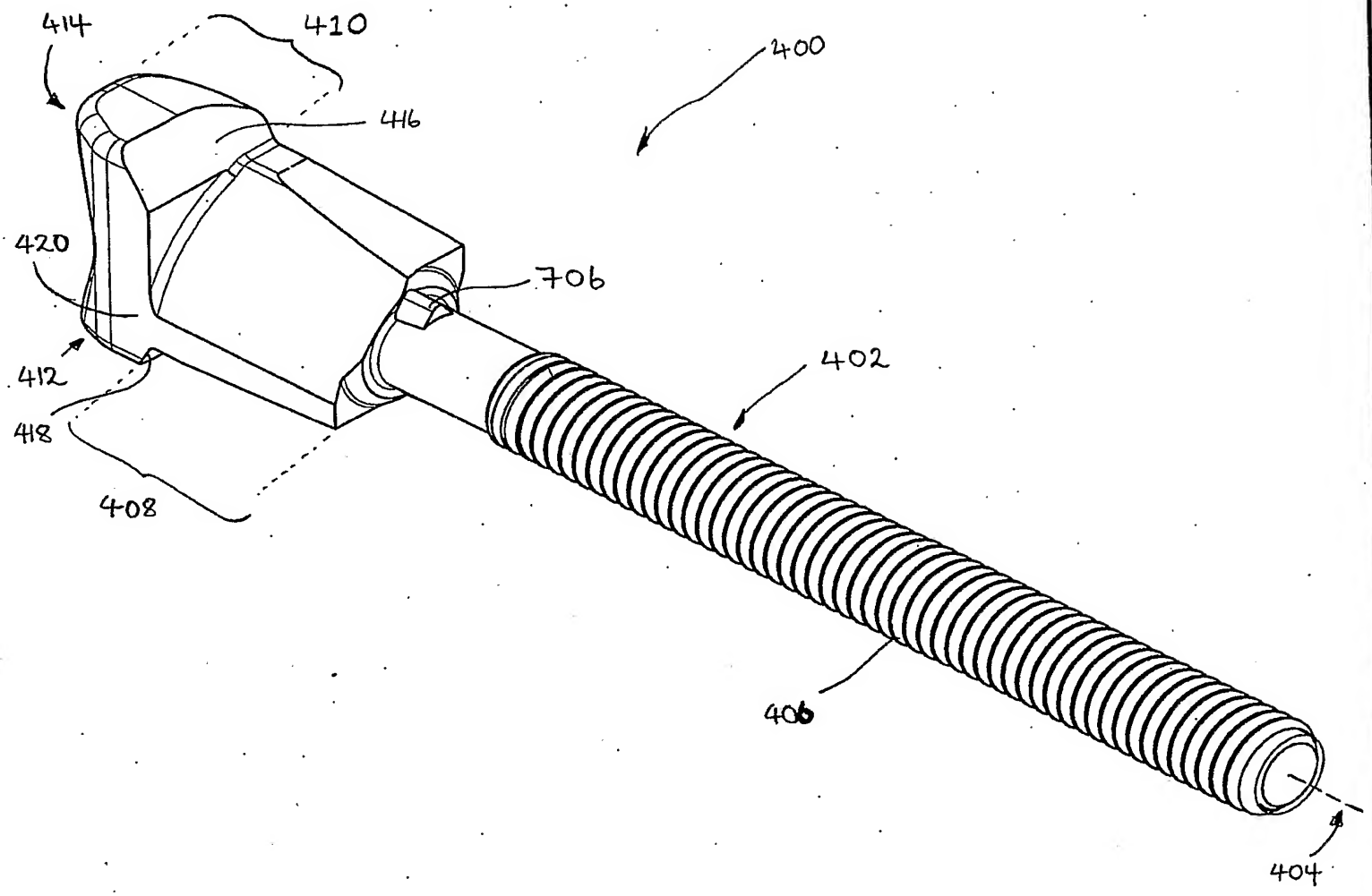


FIGURE 4

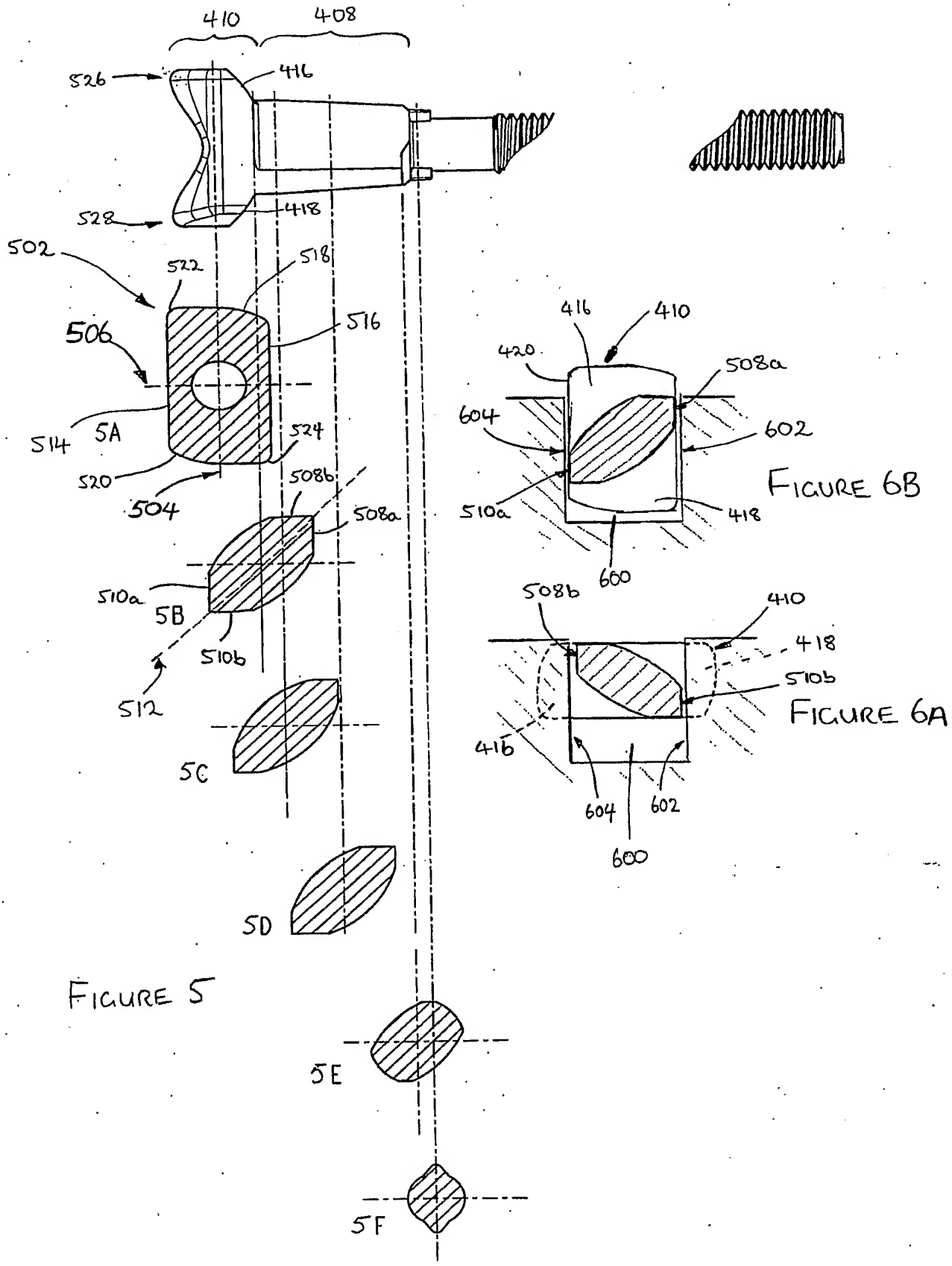


FIGURE 5

FIGURE 6B

FIGURE 6A

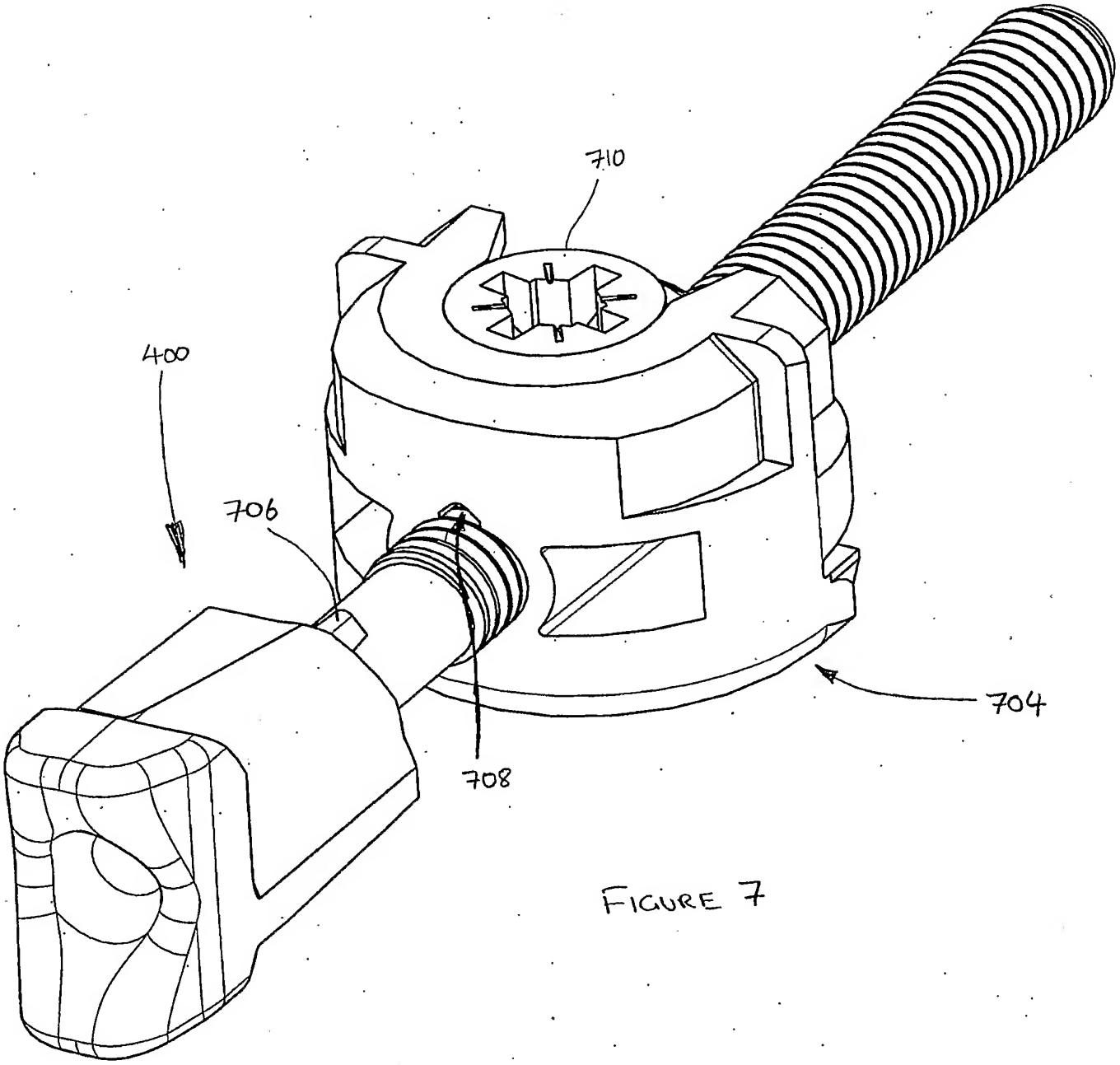
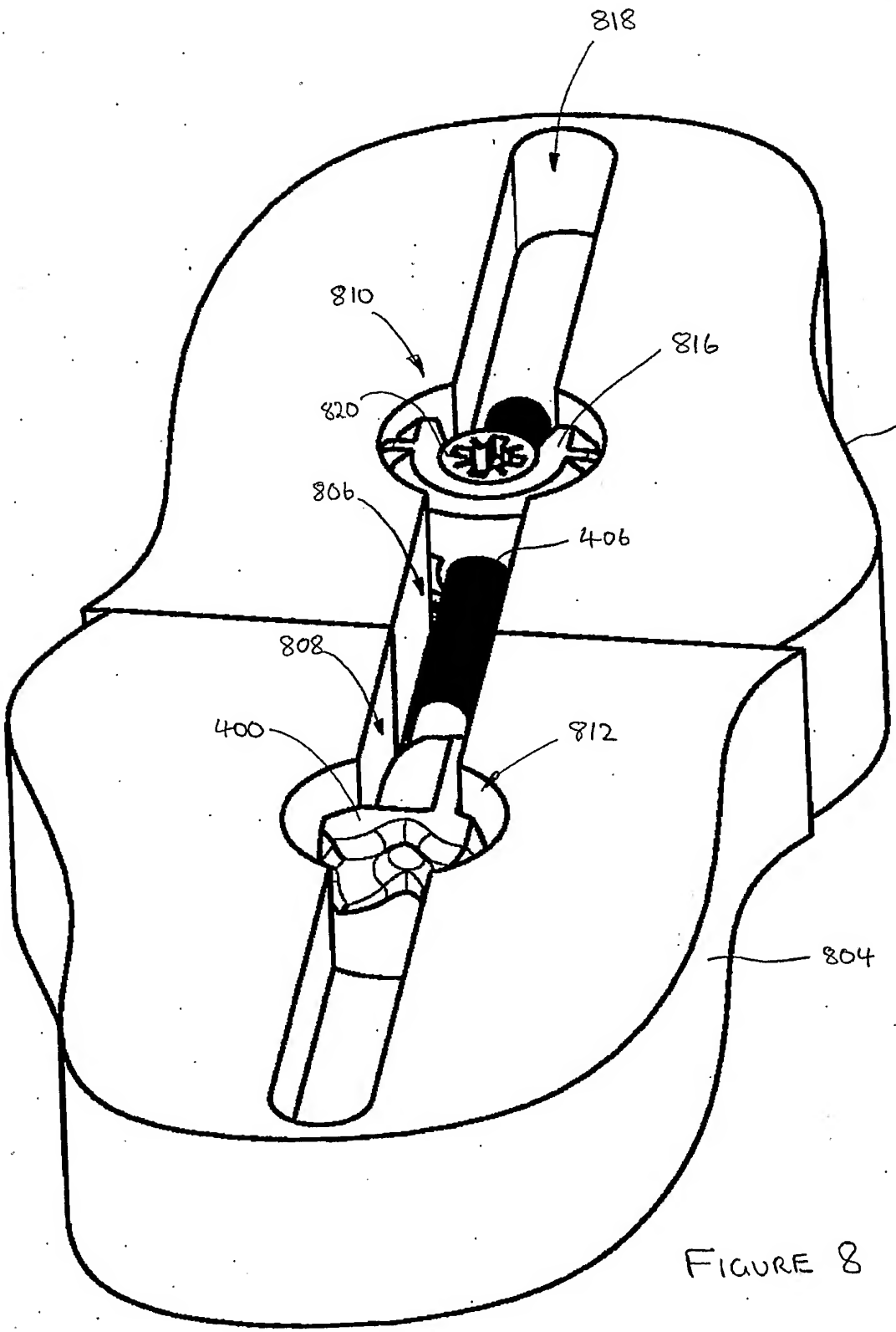


FIGURE 7



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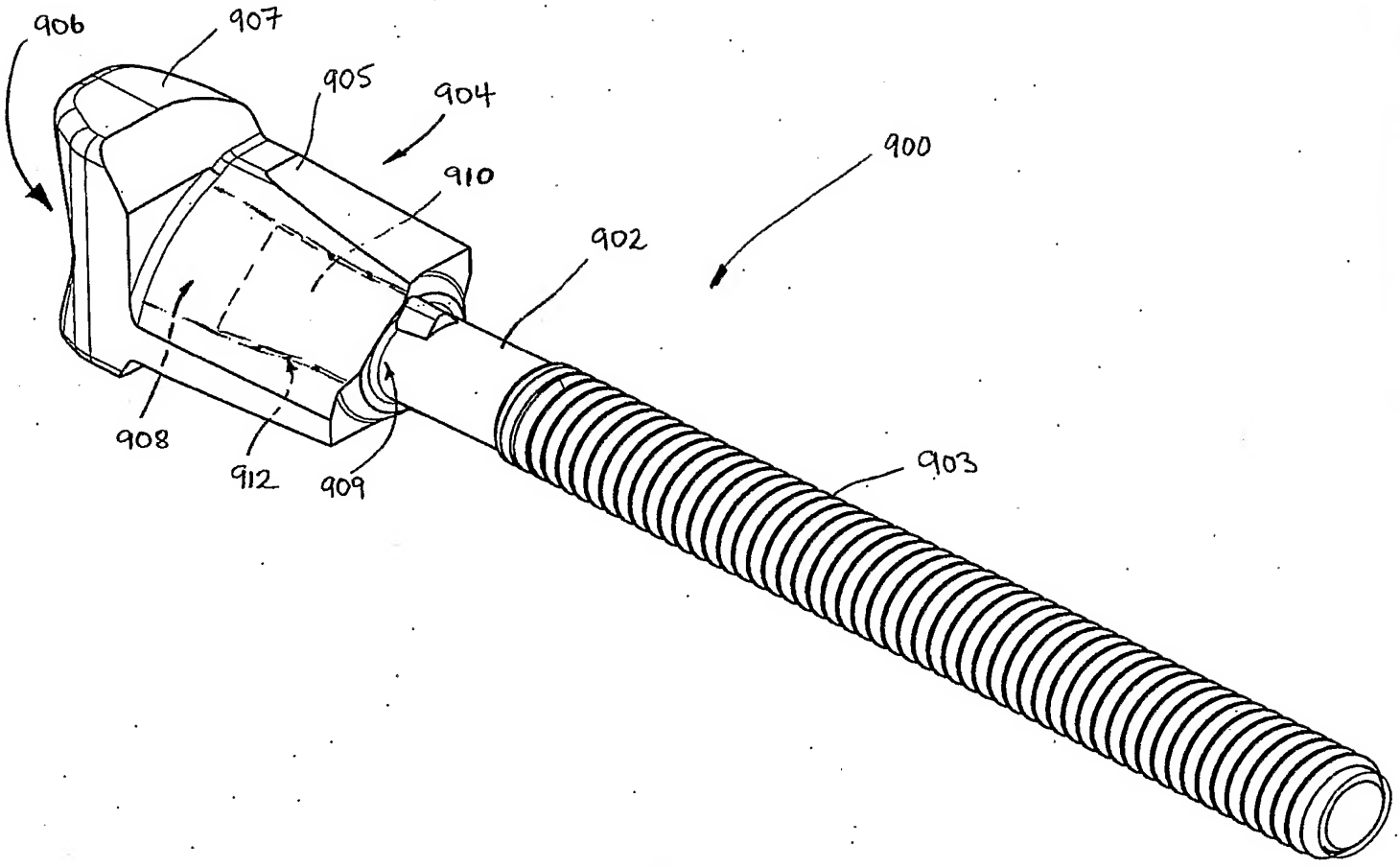

FIGURE 9